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FOREST RESEARCH in the SOUTHEAST

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SOUTHEASTERN FOREST EXPERIMENT
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Decline in Growth of Pine in the Southeast

Periodic timber inventories by the Southeastern Forest Experiment Station show that net annual growth of pine in the Atlantic Coast States from Virginia to Florida has peaked and turned downward after many years of increase. This decline, which will be translated into a smaller volume of timber for harvest in the long run, was not expected to occur until the 1990's. Station Resources Analysts, therefore, decided upon a comprehensive analysis of pine growth over the past 30 years in the Southeast.

Results of that analysis are disturbing. They show that average annual radial growth of yellow pines under 16 inches in diameter has declined by 30 to 50 percent over a 30-year period. Earlier analyses over periods of 20 years had indicated that the declines were concentrated on the Piedmont Plateau. Looking backward an additional 10 years, Resources Analysts found that a similar decline had occurred on the Coastal Plain, but that it had occurred approximately 10 years sooner.

Foresters know that the radial growth of individual trees is not a very reliable indicator of stand growth. The growth of individual trees decreases as stand density increases, and the average density of pine stands has been increasing. Similarly, growth of individual trees tends to decline as a stand ages, and the average age of southern pine stands has been rising.

The long-term Forest Survey data on which the analysis was based are not ideal for measuring effects of changes in age and stand density, but

results indicate that these factors do not account for the majority of the growth decline. Basal area growth per acre has declined almost as much as radial increment of individual trees. This result tends to rule out increasing stand density as a primary cause for the declines.

Other possible causes include atmospheric pollution, increased competition from hardwoods, drought, lowering of water tables on the Coastal Plain, loss of old-field conditions, and increases in disease impacts. All of these factors, plus others, are being investigated in studies by Station, university, and forest industry scientists.

Whatever the cause, the slowdown in pine growth adds to the problems associated with maintenance of supplies of this critical raw material for southern forest industry. Other problems are a shrinkage of forest acreage and the failure of many landowners to replace pines after harvests.

The Southeastern Station recently released results of the detailed analysis of Forest Survey data on pine growth. Single copies of the Resource Bulletin, "Pine Growth Reductions in the Southeast," can be obtained by checking RB-83 on the back cover.

The Value of Shade Trees

Even if they do have to rake leaves and live with an occasional clogged sewer line, most owners of single-family houses like to have a few trees in their yards. Recent research shows that this appreciation for trees translates into dollars when a house goes up for sale.

A study of real estate listings and house sales in Athens, GA, gives some indication of the value of trees on residential property. Comparable single-family dwellings there sold for 3 to 5 percent more if trees were part of the landscaping. Apparently,

people are willing to spend a little more to obtain the beauty, shade, privacy, windbreaking, and wildlife habitat that trees provide in urban settings.

The increased property value also means increased property tax revenues for a city. Thus, money is available to dispose of debris produced by urban trees.

Copies of the article describing the study of property values can be obtained by checking R-962 on the back cover.

Foundation Walls of Wood Stay Dry

There's a lot to be said for a basement under your house--if you can afford one. Basements provide extra living space and storage areas. They are an out-of-the-way place for the furnace and various appliances. They can be ideal for game rooms and workshops. A poured concrete basement, however, can add 30 percent to the cost of constructing a new home, and the cost of that work under an existing building is usually prohibitive.

An all-weather wood foundation is a lot cheaper, and it can be an acceptable substitute. Station Scientists, working with the American Wood Preservers Institute, the National Forest Products Association, and the American Plywood Association, developed this alternative. Wood for the foundation must be specially pressure-treated to prevent termite damage and wood decay.

What about moisture problems? A recently published report in the FOREST PRODUCTS JOURNAL shows that can be avoided in a properly designed wood foundation. Such a foundation was constructed with built-in moisture probes, and the moisture content of the treated wood was monitored for 5 years.

Industrial research has shown that problems with metal fasteners, odors, mildew, decay, and structural stability do not develop in the treated wood until the moisture content of the wood exceeds 19 percent for extended periods. In the test foundation, less than 1 percent of the recorded plywood and stud measurements exceeded this value. Moisture contents were highest during wet periods in the summer. The foundation was rated a success.

Reprints of the article describing this research may be obtained by checking R-970 on the back cover.

Improving Regeneration for Southern Appalachian Hardwoods

Acceptable young stands of Appalachian hardwoods can usually be obtained by clearcutting mature stands if the treatment is properly applied. Often, however, the treatment that is required is both costly and difficult. The clearcut must be complete. That is, undesirable as well as desirable stems must be eliminated from the old stand. Loggers are happy to take the desirable stems; the undesirable ones have traditionally been felled after the harvest at considerable expense. Adding to the problem is a tendency of some undesirable species to sprout prolifically and occupy large areas in the new stand.

Many of these problems can be avoided, and costs reduced, by treating the unmerchantable stems with herbicide before harvest. At that time, the work crew doesn't have to fight its way through logging slash to get to the target trees. In addition, when the trees are treated in this manner, sprouting is minimized.

A 10-year study recently described in the SOUTHERN JOURNAL OF APPLIED FORESTRY demonstrates

that stands that develop after preharvest herbicide treatment are overwhelmingly dominated by desirable species. On control plots where undesirable stems were felled after harvest, sprout clumps have displaced desirable species in some areas. Conclusion: Preharvest herbicide treatment costs less and gets better results.

Reprints of the article describing this research can be obtained by checking R-975 on the back cover.

New Approach to Forestry Decisions

Conservation rather than liquidation is the theme of forestry, but more of the public views timber harvesting as liquidation despite the best efforts of managers to produce multiple benefits. A new way of scheduling harvest and cultural practices to achieve multiple goals could do much to correct public misperceptions.

The new approach is described in detail in a book just published by the Southeastern Station: "Forestry Decisions" by Stephen G. Boyce. The approach begins by asking new questions whose answers lead to decision and control. Instead of asking, "How much game, timber, this, and that do we want to produce," we ask, "If we adopt a certain practice, what will we have?" Decisions are based on answers to the questions: How will this schedule of culture change the forest over time? What monetary returns will we have? What will be the stream of benefits through time? What will be the potential productivity of the forest? For a particular forest, answers to these questions can be estimated by computer.

The approach represents a change in the way we view the forest. A forest is seen as a biological system that self-organizes in response to culture

rather than as a manufacturing plant that puts out timber, game, and other benefits at the will of managers. Control becomes a process of using silviculture to direct the self-organizing forces to transform the forest from the present state through a stream of desired future states.

Each state of forest organization provides some combination of materials for harvest and some physical structure for nonharvestable benefits. Decisions and their attendant controls provide for game and nongame animals, trees for timber, shrubs and herbaceous plants, and conservation of a wide variety of germ plasm for the livelihood of man.

This new direction of decision and control depends on the concept that behavior of complex systems such as forests is principally caused by structure and the connections among component parts. It is an ecological approach in which complexity is reduced through computer simulation.

Single copies of "Forestry Decisions" can be obtained by checking GTR-35 on the back cover.

Loblolly Pine Management Guides

On poorly drained, heavy soils, logging can seriously damage the area by destroying soil structure, blocking drainage, injuring seedlings, and transporting valuable nutrients. As much as two-thirds of a logged area can be damaged, and costs in lost productivity can be $60 to $90 per acre on Coastal Plain sites.

Historically, the blame for this damage has been placed on the logging contractor, but much of the damage can be prevented by a land manager through careful planning of the timber sale and preparation of the site for the logging operation. Careful control is then needed during the logging.

Finally, much of the lost productivity can be restored by cultivation and fertilization. Obviously, however, the less damage done to the site, the better.

Appropriate methods for managing site damage from logging are described in a new Southeastern Station publication. Copies of this potentially useful guide can be obtained by checking GTR-32 on the back cover.

This report is the first of a series of guides for the management of loblolly pine, the most important timber species in the South. Others that soon will be published are about fertilizer application and nutrient cycling.

List of Recent Publications

R-1 Alexander, Samuel A.; Anderson, Robert L. **How to: identify and control annosus root rot in the South.** For. Bull. R8-FB/P 19. Atlanta, GA: U.S. Department of Agriculture, Forest Service, Southern Region; 1985.

Annosus root rot is a major disease of conifers throughout the north-temperate regions of the world. In the Southern United States, the disease is most serious in pine stands, where it causes a reduced growth rate and a higher susceptibility to attack by bark beetles. This 8-page leaflet with color photos is a concise aid in identification of the disease.

R-2 Anderson, L.M.; Cordell, H.K. **Residential property values improved by landscaping with trees.** Southern Journal of Applied Forestry 9(3):162-166; 1985.

A survey of house sales from 1978 to 1980 shows a 3 to 5 percent increase in the sales prices of single-family houses in Athens, GA, directly related to the presence of trees in their landscaping.

R-3 Askew, G.R.; Hedden, R.L.; DeBarr, G.L. **Clonal variation in susceptibility to coneworms (Dioryctria spp.) in young loblolly pine seed orchards.** Forest Science 31(3):794-798; 1985.

Of 25 seed orchards examined for coneworm damage, 8 had significant clonal variation in coneworm infestation rates, ranging from 0 to 67 percent infested cones. Selection against susceptible clones or custom-designed insecticide treatments may reduce the pest problem and minimize the cost of chemical control.

R-4 Barrows-Broaddus, Jane; Dwinell, L.D.
Branch dieback and cone and seed infection caused by Fusarium moniliforme var. subglutinans in a loblolly pine seed orchard in South Carolina. Phytopathology 75(10):1104-1108; 1985.

Incidence of shoot dieback in a loblolly pine seed orchard varied by clone. All but the most susceptible clones recovered from the dieback. Fusarium moniliforme var. subglutinans was isolated from branches, conelets, mature cones, and seeds. The pattern of fungus isolation and the histological data indicated that outbreaks of shoot dieback and conelet deterioration could occur independently.

R-5 Barrows-Broaddus, Jane; Dwinell, L.D.; Kerr, T.J.
Evaluation of Arthrobacter sp. for biological control of the pitch canker fungus (Fusarium moniliforme var. subglutinans) on slash pines. Canadian Journal of Microbiology 31:888-892; 1985.

Slash pines were wounded, treated with Arthrobacter sp., and then inoculated 24 hours later with Fusarium moniliforme var. subglutinans, the causal organism of pine pitch canker. Two Arthrobacter isolates significantly decreased the numbers of conidia of the pitch canker fungus collected from surfaces of inoculated wounds. Pitch cankers developed on trees inoculated 1 day after wounding but not on trees inoculated 7, 14, or 21 days after wounding. Thirteen months after treatment, the numbers of F. moniliforme var. subglutinans and arthrobacters were greatly reduced or were absent from washes and wood samples on wound surfaces.

R-6 Berry, C.R.
Growth and heavy metal accumulation in pine seedlings grown with sewage sludge. Journal of Environmental Quality 14(3): 415-419; 1985.

Loblolly pine seedlings were grown in microplots amended with two rates of one of five sewage sludges: old and fresh sludges, both from Athens, GA; and sludges of undetermined age from Aiken, SC, Newberry, FL, and Chicago, IL. Newberry sludge and fresh Athens sludge supported growth comparable to the inorganic fertilizer control. Seedlings grown with Chicago sludge grew well at the high rate but were not as large as those grown with fertilizer. Seedlings grown with old Athens or Aiken sludge did not grow well, and most of them were not of plantable size.

GTR-35 Boyce, Stephen G.
Forestry decisions. Gen. Tech. Rep. SE-35. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1985. 318 pp.

Viewing the forest as a system that self-organizes in response to a schedule of harvest and culture provides a new basis for making forestry decisions. Computer simulations of states of forest organization display the wide range of forest benefits from which the manager can choose a desired schedule.

RB-81 Brown, Mark J.
Forest statistics for the Southern Piedmont of Virginia, 1985. Resour. Bull. SE-81. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1985. 55 pp.

Since 1976 the area of timberland in the Southern Piedmont of Virginia has remained at nearly 3.8 million acres. Almost 64,000 acres were harvested annually and retained in timberland. More than 57,000 acres of timber stands were regenerated annually; nearly half of them were planted artificially. Softwood removals increased nearly 7 percent and growth exceeded removals by 9 percent. Hardwood removals were up 9 percent and growth exceeded removals by 63 percent.

RB-80 Brown, Mark J.; Craver, Gerald C. **Forest statistics for the Coastal Plain of Virginia, 1985.** Resour. Bull. SE-80. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1985. 53 pp.

Since 1976 the area of timberland in the Coastal Plain of Virginia declined by 230,000 acres, or 6 percent. More than 72,000 acres were harvested annually and retained in timberland. Volume of softwood growing stock declined 3 percent, whereas hardwood growing-stock volume increased 3 percent. Net annual growth averaged 62 cubic feet per acre--little change from the previous survey.

R-7 Cubbage, Frederick W.; Saucier, Joseph R. **Hardwood fuelwood in North Georgia: resources, utilization, and harvesting.** Ga. For. Res. Pap. 58. Macon, GA: Georgia Forestry Commission, Research Division; 1985. 10 pp.

In a comparison of a small skidder and a skyline yarder to determine potential harvesting costs, the skidder performed well for small hardwoods on slopes up to 20 percent. Used to their capacity and operated full time, average logging costs with these

machines would be reasonable for firewood harvests. Because of low prices for dirty chips, the outlook for industrial fuelwood harvested under these circumstances was not economically promising.

R-8 DeBarr, Gary L.; Matthews, Fred R. **Insecticide applications during the pollination period do not adversely affect seed yields of loblolly pine.** Southern Journal of Applied Forestry 9(10):240-243; 1985.

Guthion®, Pydrin®, and Ambush® were applied to catkins and to ovulate strobili of loblolly pines at the time of maximum ovulate receptivity to determine their effects upon pollen viability, ovulate strobili survival, seed set, seed yields, and seed viability. Treatments did not significantly reduce the number of pollen grains/ovule, survival of ovulate strobili, number of developed seeds/cone, number of filled seeds/cone, germination of full seed, or cause an increase in abnormal seed germination.

R-9 Della-Bianca, Lino; Beck, Donald E. **Selection management in Southern Appalachian hardwoods.** Southern Journal of Applied Forestry 9(3):191-196; 1985.

A tract of Southern Appalachian cove hardwoods and mixed oak, managed under the selection system of silviculture since 1946, showed that simply cutting in all commercial diameter classes (i.e., 6.0 inches and larger) during the first 24 years failed to develop enough desirable saplings and poles to maintain the system. After 1970, herbicide treatment of undesirable, tolerant understory species in openings created by removal of large trees or groups of trees has improved the status of desirable saplings.

R-10 de Steiguer, J.E.
Acid deposition impacts on eastern forests: a research response. In: Proceedings, Hardwood Research Council annual symposium; 1985 May 22-24; High Point, NC: Hardwood Research Council; 1985:27-34.

Acid rain has become the most controversial environmental issue facing forestry today. This paper discusses current knowledge on the effects of acid rain on forests and outlines the research programs at the Southeastern Station that are linked to the nationwide increase in air pollution research.

R-11 Drooz, A.T.; Ghent, J.H.; Huber, C.M.
Insect parasites associated with the introduced pine sawfly, Diprion similis (Hartig) (Hymenoptera: Diprionidae), in North Carolina. Environmental Entomology 14(4):401-403; 1985.

The parasitic fauna of Diprion similis in North Carolina was investigated by rearing field-collected cocoons from 1978 to 1982. The torymid, Monodontomerus dentipes (Dalman), and the eulophid, Dahlbominus fuscipennis (Zetterstedt), were transferred from Wisconsin, and small numbers of three European species of egg parasites were also released.

R-12 Drooz, A.T.; Quimby, J.W.; Thompson, L.C.; Kulman, H.M.
Introduction and establishment of Olesicampe benefactor Hinz (Hymenoptera: Ichneumonidae), a parasite of the larch sawfly, Pristiphora erichsonii (Hartig) (Hymenoptera:Tenthredinidae), in Pennsylvania. Environmental Entomology 14(4): 420-423; 1985.

The ichneumon, Olesicampe benefactor Hinz, was transferred from Minnesota in 1975, in an attempt to suppress the larch sawfly, Pristiphora erichsonii (Hartig) from defoliating Larix spp. Dissections of prepupae indicated that 59 percent of the hosts were parasitized by 1983 at the initial release site.

R-13 Gaby, Louis I.
Moisture content in a wood foundation wall. Forest Products Journal 35(6):41-44; 1985.

A treated-wood basement foundation was installed and instrumented to measure moisture content (MC) and temperature of wood below grade. The test wall was unfinished on the interior side. Wood MC cycled with seasonal changes of the interior environmental conditions.

R-14 Hatchell, G.E.; Berry, C.R.; Muse, H.D.
Nondestructive indices related to aboveground biomass of young loblolly and sand pines on ectomycorrhizal and fertilizer plots. Forest Science 31(2):419-427; 1985.

Evidence is presented to support the use of root-collar diameter squared x total height (D^2H) as a surrogate measure for aboveground biomass of young pine seedlings. D^2H performed well compared with other surrogate measures of interest: H, D, D^2, and DH.

RB-82 Huber, Cindy M.; McClure, Joe P.; Cost, Noel D.
Incidence and impact of damage to North Carolina's timber, 1984. Resour. Bull. SE-82. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1985. 27 pp.

In North Carolina, annual mortality for all live hardwood timber was about 122 million cubic feet; for softwood timber, 119 million cubic feet. Losses, by major timber species and damaging agent, are shown in tables.

RB-79 Hutchins, Cecil C., Jr.
Southern pulpwood production, 1983. Resour. Bull. SE-79. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1985. 26 pp.

Pulpwood production in the South was 56.6 million cords in 1983, an 8 percent increase since 1982. Roundwood production increased by 6.6 percent and residue by 12 percent.

R-15 Johansen, R.W.
Effect of drought on live fuel moisture content. In: Donoghue, Linda R.; Martin, Robert E., eds. Weather--the drive train connecting the solar engine to forest ecosystems: Proceedings of the 8th conference on fire and forest meteorology; 1985 April 29 - May 2; Detroit, MI; 1985:47-51.

Actual moisture content determinations were made twice a week on four plant species and comparisons were made with eight calculated indices of drought or live fuel moisture. Only the Keetch-Byram Drought Indices had a consistent correlation with one of the species tested, but this index accounted for only 37 percent of the moisture content variation.

R-16 Knight, Herbert A.
Recent survey findings and growth rates in the Southeast. In: Cubbage, Frederick W., ed. Trends in growing and marketing

southern timber. Proceedings of the 1985 southern forest economics workshop; 1985 March 13-15; Athens, GA. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1985:44-52.

This paper addresses some of the factors affecting a recent downturn in the growth of pine timber in the Southeast. A decline in area of timberland, inadequate regeneration following harvesting, an increase in mortality, and a slowdown in individual tree diameter growth are discussed.

GTR-33 Koenigshof, Gerald A.
Performance and quality-control standards for composite floor, wall, and truss framing. Gen. Tech. Rep. SE-33. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1985. 20 pp.

Users must be assured that composite structural members are satisfactory for their intended purposes. Standards are provided for strength, stiffness, durability, and dimensional stability of composite floor, wall, and truss-framing members. Methods for enforcing compliance with the standards are suggested.

R-17 Kormanik, Paul P.
Effects of phosphorus and vesicular-arbuscular mycorrhizae on growth and leaf retention of black walnut seedlings. Canadian Journal of Forest Research 15:688-693; 1985.

Black walnut seedlings were grown in fumigated soil without vesicular-arbuscular (VA) mycorrhizal fungi or in soil infested

with Gigaspora margarita, Glomus fasciculatum, or G. macrocarpum. For each mycorrhizal treatment, three levels of available phosphorus (P) were provided. With 25 and 50 p/m P, the presence of VA mycorrhizae significantly improved leaf retention and root weight of all seedlings. At 75 p/m P, seedling development was not affected by mycorrhizal treatment.

R-18 Lewis, Clifford E.; Monson, Warren G.; Bonyata, Richard J.
Pensacola bahiagrass can be used to improve the forage resource when regenerating southern pines. Southern Journal of Applied Forestry 9(10):254-259; 1985.

Following site preparation by shearing and strip-disking, Pensacola bahiagrass was seeded in the spring and longleaf pine was row-seeded in December of the next year. The bahiagrass became established among the residual native plants and was heavily utilized by cattle grazing yearlong. Light fertilization after 3 years tripled bahiagrass yields the first year and doubled it the next year compared with unfertilized plots. Longleaf seedlings came out of the grass stage more rapidly and were 50 percent taller at age 9 with grazing than without.

R-19 Loftis, David L.
Preharvest herbicide treatment improves regeneration in southern Appalachian hardwoods. Southern Journal of Applied Forestry 9(3):177-180; 1985.

Preharvest herbicide treatment of undesirable and unmerchantable vegetation was compared with postharvest felling. Ten years after the clearcut harvesting, the preharvest treatment had increased the number and

proportion of desirable stems and decreased the number and proportion of undesirable sprouts in the dominant stand.

GTR-32 McKee, W.H., Jr.; Hatchell, G.E.; Tiarks, A.E.
Managing site damage from logging. A loblolly pine management guide, Gen. Tech. Rep. SE-32. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1985. 21 pp.

Serious damage to forest sites during logging can be avoided through careful planning of logging, preparation of the site for logging, and close supervision of the work. Losses in productivity caused by compaction can be largely restored by cultivation and fertilization.

R-20 McKee, William H., Jr.
Forestry and forest management impacts on wetlands. In: Groman, Hazel A.; Henderson, Timothy R.; Meyers, Erik J. [and others], eds. Proceedings of the conference--wetlands of the Chesapeake; 1985 April 9-11; Easton, MD; 1985:216-224.

Forested wetlands, a valuable source of timber, need to be harvested through proper management techniques to avoid sedimentation, nutrient enrichment of runoff, and deterioration of soils and drainage patterns. Practices that utilize a shelterwood cut, prescribed burning, site preparation, phosphorus fertilization, or hazard indices of probability of damage during the wet season will minimize such problems. In areas where soils have been compacted and drainage impaired, site restoration through disking, bedding, and stand regeneration are

the proper remedies. While most wetland forests can be logged by using proper techniques, some are better left alone to avoid destruction of wildlife habitat, impairment of water quality, and reduction of flood protection capacity.

R-21 McMahon, C.K.; Clements, H.B.; Bush, P.B. [and others].
Pesticides released from burning treated wood. In: Donoghue, Linda R.; Martin, Robert E., eds. Weather--the drive train connecting the solar engine to forest ecosystems. Proceedings of the 8th conference on fire and forest meteorology; 1985 April 29 - May 2; Detroit, MI; 1985:145-152.

Wood treated with five herbicides (2, 4-D, picloram, hexazinone, dicamba, and dichloroprop) and two insecticides (lindane and chlorpyrifos) were burned under controlled combustion conditions to simulate the wide range of thermal environments to be found in domestic wood stoves and fireplaces. Over 95 percent pesticide decomposition occurred when the wood was burned under conditions of rapid (flaming) combustion.

R-22 McMahon, Charles K.; White, Jerry D.; Tsoukalas, Skevos N.
Organic compounds in the particulate matter from burning organic soils. In: Proceedings, Air Pollution Control Association specialty meeting; 1984 March 7-9; Raleigh, NC. Pittsburgh, PA: Air Pollution Control Association; 1984:169-180.

Small wet and dry blocks of organic soil collected from south-central Florida were burned under controlled conditions in the laboratory. Dry soils produced high particulate matter emission factors for the

first 24 hours of burning and low factors for the later periods. The reverse was true for the wet soils. Carbon monoxide levels were high for all fires.

R-23 McNab, W. Henry; Berry, Charles R. **Distribution of aboveground biomass in three pine species planted on a devastated site amended with sewage sludge or inorganic fertilizer.** Forest Science 31(2): 373-382; 1985.

Five-year-old loblolly, shortleaf, and Virginia pines growing on sites initially planted on plots amended with dried sewage sludge or inorganic fertilizer and CaO were felled, separated into stem and branches plus foliage, and sampled to determine relative amounts of wood, bark, and foliage. Regardless of fertility treatment, less than half of the total tree biomass for shortleaf and loblolly consisted of branches, but dry weight of branches for Virginia pine was twice that of the main stem. In terms of biomass composition, trees growing on plots amended with sewage sludge averaged about 8 percent more wood as a percentage of total tree weight and proportionately less foliage than trees on plots amended with inorganic fertilizer.

P-252 McNab, W. Henry; Outcalt, Kenneth W.; Brendemuehl, Raymond H. **Weight and volume of plantation-grown Choctawhatchee sand pine.** Res. Pap. SE-252. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1985. 44 pp.

The aboveground green weight of the total tree and its major components, the main stem and crown, were determined in eight stands of planted Choctawhatchee sand pine ranging

in age from 7 to 27 years. Equations for predicting individual tree green and dry weights and cubic volumes of wood, and of wood and bark, were developed for the main stem and crown of each canopy class.

R-24 McReynolds, Robert D.; Kossuth, Susan V. **CEPA in liquid sulfuric acid increases oleoresin yields.** Southern Journal of Applied Forestry 9(3):170-173; 1985.

Liquid sulfuric acid solutions were tested in combination with 2-chloroethylphosphonic acid (CEPA) for increasing oleoresin yield in slash (Pinus elliottii) and longleaf (P. palustris) pines. The addition of CEPA to any sulfuric acid concentration always increased yields, and increasing sulfuric acid concentrations without CEPA always increased yields. The sulfuric acid and CEPA effects were both significant but no interaction between them was detected for either slash or longleaf pines. Highly significant differences in yield were found among the clones.

R-25 Marx, D.H.; Hedin, Arne; Toe, Sieh F.P., IV **Field performance of Pinus caribaea var. hondurensis seedlings with specific ectomycorrhizae and fertilizer after three years on a savanna site in Liberia.** Forest Ecology and Management 13:1-25; 1985.

Seedlings grown in containers were treated with inoculum of the mycorrhizal fungi Pisolithus tinctorius and Thelephora terrestris, or a topsoil collected under 16-year-old trees near Monrovia. Growth of these seedlings after outplanting on a savanna site varied by mycorrhizal fungus species and was influenced by fertilizer application to the planting site.

R-26 Namkoong, Gene

The population genetic basis of breeding theory. In: Gregorius, H.-R., ed. Population genetics in forestry, proceedings of IUFRO Working Party "Ecological and population genetics"; 1984 August 21-24; Göttingen, Germany. New York: Springer-Verlag; Lecture Notes in Biomathematics 60:1-15; 1985.

The present understanding of gene actions in forest trees and the interaction of selection and mating systems are discussed, and some implications are drawn for breeding in partially managed forests.

R-27 Neary, D.G.; Bush, P.B.; Douglass, J.E.; Todd, R.L.

Picloram movement in an Appalachian hardwood forest watershed. Journal of Environmental Quality 14(4):585-592; 1985.

Picloram was applied to 4 ha of the 28-ha Watershed 19, Coweeta Hydrologic Laboratory in western North Carolina to eliminate a poor-quality mixed oak overstory and rhododendron understory prior to planting white pine. Picloram residues had a half-life of about 4 weeks, and declined to near detection limits 28 weeks after application. Soil solution contained the highest picloram levels. Only sporadic, low-level picloram residues were detected in streamflow from nested 10-ha and 28-ha watersheds during a 70-week period.

R-28 Nord, John C.; Ragenovich, Iral; Doggett, Coleman A.

Pales weevil. For. Insect & Dis. Leafl. 104. Washington, DC: U.S. Department of Agriculture, Forest Service; 1984. 11 pp.

Describes damage, hosts, biology, and control of the most serious insect pest of pine seedlings in the Eastern United States. Color photos of life stages of the insect and of its damage are an aid in identification of the pest.

R-29 Paul, James T.; Pierovich, John M. **A decade with the Forestry Weather Interpretation System (FWIS).** In: Donoghue, Linda R.; Martin, Robert E., eds. Weather--the drive train connecting the solar engine to forest ecosystems. Proceedings of the 8th conference on fire and forest meteorology; 1985 April 29 - May 2; Detroit, MI; 1985:58-65.

This paper summarizes some of the administrative and technical problems and opportunities encountered in developing and testing an automated near-real time forestry weather system.

R-30 Ruehle, John L.; Wells, Carol G. **Development of Pisolithus tinctorius ectomycorrhizae on container-grown pine seedlings as affected by fertility.** Forest Science 30(4):1010-1016; 1984.

Effects of different fertility regimens on development of Pisolithus tinctorius (Pt) ectomycorrhizal on container-grown loblolly pine seedlings were tested in the greenhouse. Vegetative Pt inoculum was mixed into both peat-vermiculite and pine bark growing media before transplanting newly germinated seedlings. A modified nutrient solution (MNS) with various concentrations of N and P was applied to each cell to saturation at 1- and 4-week intervals for 15 weeks; 7 weeks later the study was terminated. Results showed that the production of plantable size seedlings with the best Pt

development in both growing media resulted when MNS containing 250 µg/ml N and 60 µg/ml P was applied every 4 weeks. This concentration of nutrient solution produced seedlings with needles containing 1.3 percent N and 0.12 percent P, whereas solutions with 400 and 80 µg/ml of N and P produced seedlings with needles containing 1.5 percent N and 0.15 percent P and with unsatisfactory Pt development on the roots.

R-31 Saucier, Joseph R.
Multi-product harvesting. Forest Farmer 44(10):18-19; 1985.

In the Southeastern United States, lack of hardwood markets is considered a major barrier to the continued development of the southern softwood resource. Changing conditions and developments that favor increased utilization of hardwoods are reviewed. Application of new resource assessment techniques and innovative harvesting systems provide promise for reversing the decline in acreage of the southern softwood resource.

R-32 Saucier, Joseph R.; Clark, Alexander, III.
Tables for estimating total tree and product weight and volume of major southern tree species and species groups. Tech. Pap. 85-A-11. Washington, DC: American Pulpwood Association; 1985. 59 pp.

This report provides convenient tables for estimating the weights and volumes for Coastal Plain southern pines, Piedmont southern pines, hard hardwoods, soft hardwoods, sweetgum, and yellow-poplar.

R-33 Saucier, Joseph R.; Phillips, Douglas R.
Storing whole-tree fuelwood chips for maximum energy. Forest Products Journal 35(6):53-56; 1985.

Successful operation of large fuelwood combustion systems requires stockpiling of fuel to assure continuous supply during adverse harvesting periods. Studies were conducted to measure the effects of pile geometry and pile venting to limit moisture increase from rainfall and loss of heat value of whole-tree chips from mixed hardwoods in open storage. Conical piles had smaller moisture increases from rainfall, but, after prolonged storage, only a small central zone of the pile remained dry. Wood substance losses became significant after 3 months of open storage.

RB-83 Sheffield, Raymond M.; Cost, Noel D.; Bechtold, William A. [and others]. **Pine growth reductions in the Southeast.** Resour. Bull. SE-83. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1985. 112 pp.

The growth of southern pines in the Atlantic Coast States from Virginia to Florida is slower now than it was in the 1960's. This slowdown, failure to establish pines after timber harvests, declining forest acreage, and increased pine mortality all have reduced volume accumulations. As a result, pine volume in the Southeast has peaked and turned downward. Tables and charts document this phenomenon.

R-34 Thatcher, R.C.; Connor, M.D. **Identification and biology of southern pine bark beetles.** Agric. Handb. 634. Washington, DC: U.S. Department of Agriculture, Forest Service; 1985. 14 pp.

The five principal species of bark beetles that are most destructive to pines in the Southern United States are described.

Symptoms of attack, adult appearance, and difference in life cycles and behavior help to distinguish among the five species. Color photos of types of damage also aid in identification of the beetles.

R-35 Wade, Dale D.
Survival in young loblolly pine plantations following wildfire. In: Donoghue, Linda R.; Martin, Robert E., eds. Weather--the drive train connecting the solar engine to forest ecosystems. Proceedings of the 8th conference on fire and forest meteorology; 1985 April 29 - May 2; Detroit, MI; 1985:52-57.

Short-term fire effects were assessed on 31 winter and spring wildfires in 1- to 8-year-old loblolly pine plantations. Three-fourths of the trees 1 to 4 years old on burned plots died the first year but those that lived are virtually all healthy and expected to reach economic maturity.

R-36 Woodson, George
Utilization of beetle-killed southern pine. Gen. Tech. Rep. WO-47. Washington, DC: U.S. Department of Agriculture, Forest Service; 1985. 27 pp.

Nearly mature southern pines are often killed by bark beetles. Removal of these trees helps control outbreaks and provides some money to landowners. Recent research shows that trees harvested soon after attack can be processed for a wide range of wood products.

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